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THE CANMET/MRL ROCKBURST RESEARCH PROJECT - AN UPDATED WORK PLAN

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MINING RESEARCH LABORATORIES

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MICROMEDIA

TAP

MINERAL RESEARCH PROGRAM
MINING RESEARCH LABORATORIES
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BACKGROUND

The original rockburst research project proposal, (Report MRP/MRL-84/84(TR), was written in the fall of 1984 in the aftermath of the rockburst incidents at Falconbridge Mine and INCO's Creighton Mine. The intention was to immediately upgrade the microseismic systems at both mines to reflect present "state-of-the-art" technology. In the intervening months both companies have partially upgraded their systems themselves. At INCO's Creighton Mine the microseismic system has been expanded to 64 channels, and the Company is in the process of bringing the processing unit to surface and interfacing it with a micro-computer. At the Falconbridge Mine the system was expanded to 13 channels, but the mine was closed at the same time. The shafts, however, are still in use in order to hoist the ore from the adjacent East Mine until the end of 1986. Consequently, the time available to record seismic activity at Falconbridge Mine has become extremely limited. With these altered conditions the following work plan is proposed:

WORK PLAN

1985/1986

Replacement of 48 geophones with accelerometers at Creighton Mine will reduce much of the noise from mining equipment and improve source location. With this conversion the system will be at the level of "state-of-the art" technology.

It is known that the major rockbursts at Falconbridge Mine are caused by a fault-slippage mechanism. In addition, medium-sized rockbursts have continued even though the mine has been closed. It is proposed that the wave forms from seismic activity at this mine be recorded over a 3 to 6 month period using a portable recorder connected to the processing unit underground. Probably a few more geophones should be installed remote from the centre of seismic activity.

A prime requirement for rockburst studies is reliable and accurate values of magnitude. At present, these values are obtained from the seismograph network of Energy, Mines and Resources. The primary function of this network is earthquake detection and the seismograph stations tend to be remote from mines. Consequently, only the larger rockbursts (i.e. greater

than 2.0 magnitude) are recorded.

Recently, a seismograph station was installed near Sudbury and connected to a processing unit at Science North and also via telephone linkage to the Seismology Division of EMR in Ottawa. This system is designed to accept an additional 3 seismograph stations.

It is proposed that two of these stations be installed on the north and west rims of the Sudbury Basin. This would allow triangulation for better source location of rockbursts which could not be located previously. Also, better magnitude values could be obtained for lower level events. The fourth station could be installed near Elliot Lake to cover mines in that area. All of these stations would be permanently connected via telephone to Science North. Analysis of magnitude and location could be done, under arrangement, with the Seismology Division of EMR. However, it is possible for CANMET and the mining companies to also have the same direct access to Science North.

A study on rockbursts in crown pillars will be initiated at Campbell Red Lake Mine. Measurements of fill pressure and stope closure will be started in narrow and wide stopes with varying cement/tailings ratios. Post-failure computer models should be run on the previous rockbursts in "F" zone to calibrate the model. Afterwards, models can be run on various sequencings of crown pillar removal.

Rockbursts due to pillar failures have been occurring during the last two years at Rio Algom's Quirke Mine. Of the 125 recorded rockbursts, 99% have occurred within the orebody. Recently, two rockbursts have occurred in areas of known pillar failure and it is concluded that these must have occurred in the hangingwall due to breakdown (caving?) of the roof strata. This provides a unique opportunity to monitor the progression of this roof failure. The geophone array at the mine is planar and, at present, vertical resolution of rockburst location is doubtful. Three to four geophones installed in surface boreholes would rectify this deficiency. Surface exploration boreholes already exist but require reaming out to a depth of about 200 m, after which special waterproofed geophones can be installed.

Recruitment of scientific personnel for this project is already underway. By the end of this year it is expected that 3 of the 5 positions will have been filled. Hands-on training for a seismologist and ground control engineer is preferable in South Africa since they have more

sophisticated microseismic systems and are already using methods of wave form analysis. Some training in the use of seismograph records is also envisaged at the Seismology Division in Ottawa. In addition, a post-doctorate seismologist with experience in rockbursts in Europe will be a visiting scientist at CANMET's Elliot Lake Laboratory.

1986/1987

During the second year of the project, decisions will have to be made on the sophisticated microseismic systems needed to study wave-form analysis, as a means of investigating rockburst mechanisms. The experience in South African systems, as well as those used in seismology, will be useful in this regard. The present microseismic systems installed at the mines seem to become overloaded with even minor rockbursts. Hence, these systems can be used for source locations and first motion studies but not for complete wave-form analysis.

Sensors with a larger range, and/or installed away from the mine (i.e. 2 km) appear to be the answer. It is envisaged that 5 three-dimensional sensors could be installed on surface surrounding a mine. Signals from each sensor could be transmitted to a central processing and memory storage at the mine and accessed via telephone link on a daily basis by the Elliot Lake Laboratory. This would be very similar to the system at Science North for transmitting seismograph signals to Ottawa. It is envisaged that two of these systems could be installed in the Sudbury area; at INCO's Creighton Mine and at Falconbridge's Strathcona or Lockerby Mines.

It is intended to install a conventional microseismic system at Lac Mineral's Macassa Mine in Kirkland Lake in 1986 when their new shaft is completed. Historically, the Kirkland Lake mines have been rockburst-prone and Macassa Mine has experienced rockbursts in crown pillars over the last few years.

Research will continue at Campbell Red Lake Mine on crown pillar stability and at Quirke Mine on failure of the hangingwall. The full complement of 5 scientific personnel should be on staff by the end of the second year.

1987/88, 88/89, 89/90

With most of the monitoring equipment installed by the end of the second year, the subsequent 3 years will be spent in collecting and analysing the microseismic data from Creighton, Strathcona/Lockerby, Campbell, Quirke and Macassa mines.

Additional studies would be initiated during the last three years dealing with distress blasting techniques, computer modelling for stress prediction and the behaviour of support systems subject to rockbursts. Details of these studies would be outlined closer to the time of their initiation.

Table 1

Estimated Contributions from Industry

Microseismic system at Creighton Mine - equipment	$300,000
Manpower $50,000/year for 5 years	$250,000
Microseismic system at Falconbridge Mine - equipment	$150,000
Manpower $50,000/year for 1 year	$50,000
Microseismic system at Strathcona Mine - equipment	$200,000
Manpower $50,000/year for 4 years	$200,000
Microseismic system at Campbell Red Lake Mine - equipment	$200,000
Manpower $50,000/year for 5 years	$250,000
Microseismic system at Quirke/Denison Mines - equipment	$220,000
Manpower $50,000/year for 5 years	$250,000
Installation of Microseismic system at Macassa Mine	$25,000
Manpower (½ time) $50,000/year for 4 years	$100,000
Plus assistance in installing sophisticated microseismic systems and other measuring equipment	
	$2,195,000

Table 2

Equipment Requirements

1985/86	Estimates
Accelerometers, Creighton Mine	$30,000
Wave-form recording, Falconbridge Mine	$40,000
3 Seismograph stations, Sudbury and Elliot Lake	$60,000
Fill pressure cells and computer modelling, Campbell Mine	$20,000
Surface geophone installation, Quirke Mine	$20,000
	$170,000

1986/87	
Conventional microseismic system, Macassa Mine	$200,000
Sophisticated microseismic system, Creighton Mine	$250,000*
Sophisticated microseismic system, Strathcona Mine	$250,000*
Wave-form analysis equipment, Elliot Lake Laboratory	$250,000*
Fill pressure cells and computer modelling, Campbell Mine	$20,000
	$970,000

1987/88/89/90	
Miscellaneous equipment with regard to distressing blasts, computer modelling and software and support systems.	$260,000
	$1,400,000

* Guess estimates at present